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International  
Mathematics and Science Olympiad  
(IMSO) for Primary School 2007

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Jakarta, November 11-17, 2007

**Instructions:**

- \* Write down your name and country on answer sheet.
- \* Answer all 6 questions in English.
- \* You have 120 minutes to work on this test.
- \* Write down your answer on the provided answer sheets.
- \* Use pen to write your answer.
- \* Use pencil only to draw figures.

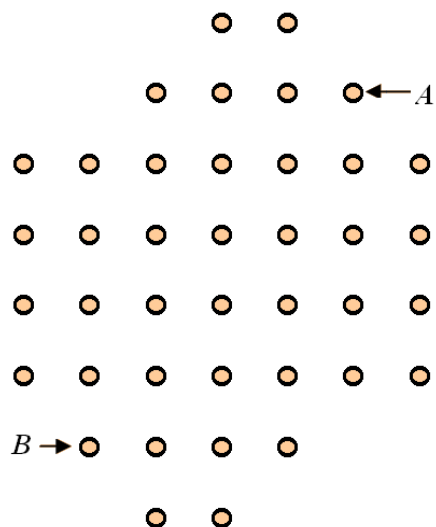
1. Positive numbers are written in order beginning with 1 in a certain pattern as shown in the figure. A cross can be drawn to enclose five numbers. For example, one such cross with center 25 is shown.

1									
2	3								
4	5	6							
7	8	9	10						
11	12	13	14	15					
16	17	18	19	20	21				
22	23	24	25	26	27	28			
29	30	31	32	33	34	35	36		
37	38	39	40	41	42	43	44	45	
...									

### Questions:

- The sum of numbers enclosed by a cross with center 72 is 361. What is the sum of numbers enclosed by a cross with center 75?
- What is the largest number enclosed by the cross with center 103?
- The sum of numbers enclosed by a cross is 1151. What is its center number?

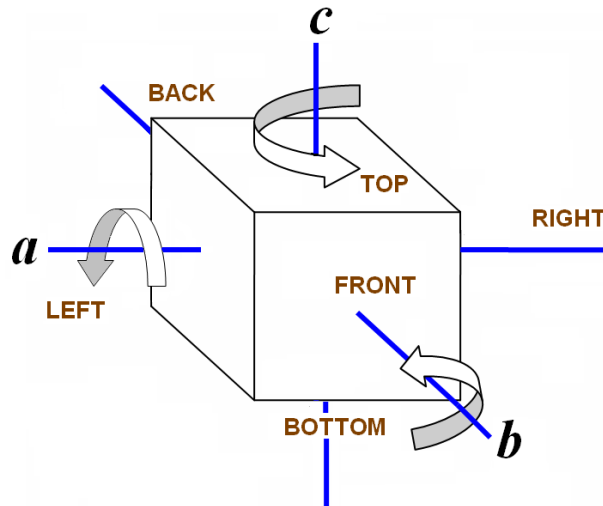
2. There are 40 dots on the paper. The vertical or horizontal distance between any two neighboring dots is 1 cm. Two dots are labelled  $A$  and  $B$  as shown in the figure.



**Question:**

A 39-centimeter string is pulled from  $A$  to  $B$  in such a way that it passes as many dots as possible. Draw one possibility of doing that!

3. A cube can be rotated about any of its three axes,  $a$ ,  $b$ , or  $c$  (see the figure). We name particular moves as follows:



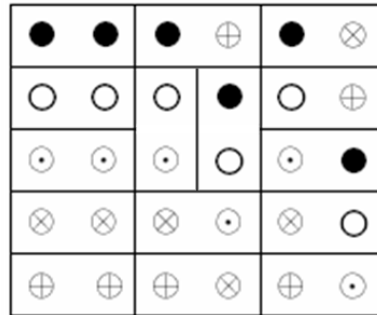
- i. The rotation of the cube  $90^\circ$  about  $a$ -axis in the direction of the arrow is called  $A$ .
- ii. The rotation of the cube  $90^\circ$  about  $b$ -axis in the direction of the arrow is called  $B$ .
- iii. The rotation of the cube  $90^\circ$  about  $c$ -axis in the direction of the arrow is called  $C$ .
- iv. Two moves written consecutively means that we do the left move first followed by the right move. For example,  $AB$  means that we do move  $A$  followed immediately by move  $B$ .
- v. We use power notation for doing the same move several times consecutively. For example, doing move  $A$  twice consecutively is represented by  $A^2$ .

You are given a cube with one of its faces marked with  $IMSO$ .

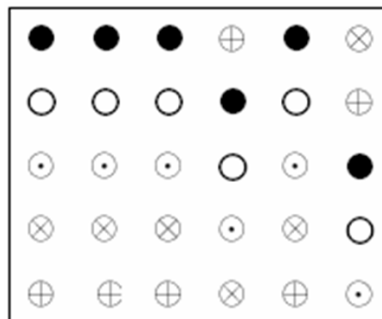
### Questions:

- (a) If face  $IMSO$  is on the front, where will this face be after we do the moves  $A^3B$ ?
- (b) If face  $IMSO$  is at the bottom after the moves  $ABC$ , where was this face before the moves?
- (c) Now let the face  $IMSO$  be on the front. We want to do some moves that will put the face  $IMSO$  back on the front with the condition that each move  $A$ ,  $B$  or  $C$  can be done at most twice. Write as many possibilities as you can.

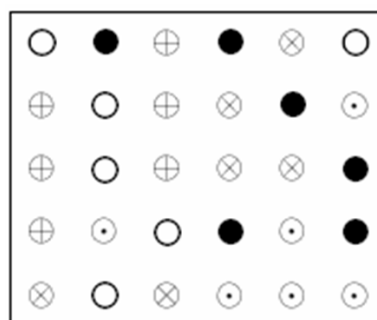
4. A puzzle consists of fifteen pieces of domino. They can be arranged as follows.



The same configuration can be drawn without boundaries of the individual domino pieces to form a  $5 \times 6$  array as shown in the diagram below.



**Question:** Determine the location of each domino piece in the following configuration by drawing the boundaries of the individual domino pieces.

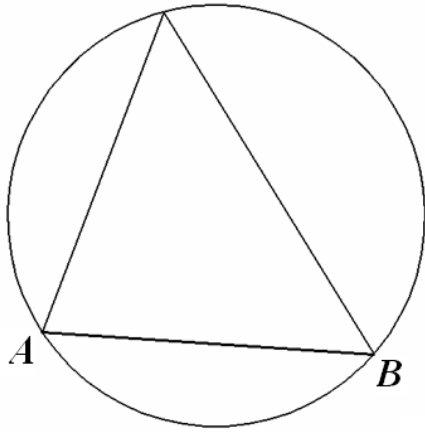


5. The following rectangular array of numbered cells must be crossed from top row to the bottom row. The rules that should be followed are:
- Only up, down, left and right movements are allowed. Diagonal movement is not allowed.
  - Each route passes every cell at most once (any cell can be passed by more than one route).
  - The digits passed by the route should form a sequence of at least two repeated blocks, for example, 1, 2, 1, 2, 1, 2, (repeating block 1, 2) or 2, 1, 3, 2, 1, 3, (repeating block 2, 1, 3) or 1, 3, 4, 2, 1, 3, 4, 2, (repeating block 1, 3, 4, 2). The last block of the sequence may not necessarily be complete.

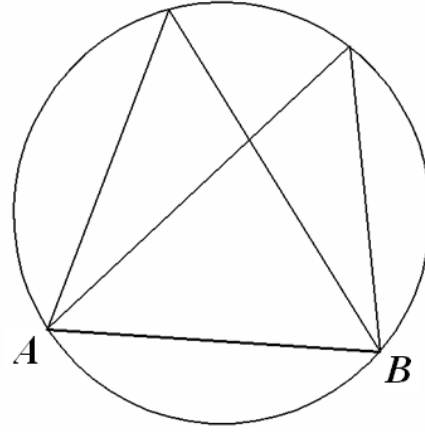
3	4	3	1	4	3	4	1
1	2	1	2	3	2	1	2
3	4	2	3	2	3	4	4
4	2	1	4	1	3	1	1
2	1	4	2	1	4	4	2
4	2	3	4	1	2	1	2
2	1	2	1	2	3	4	1
4	3	4	4	3	2	3	2
2	2	1	2	4	1	4	1

**Question:** Draw as many routes from any cell on the top row to any cell at the bottom row following the rules above.

6. In the figures below, chord  $AB$  is called *base*. Fixing a point on the circle above the base and drawing straight lines to connect the point to the two endpoints of the base, we can construct a triangle. For example, Figure (a) shows one triangle constructed from the base and one point on the circle, Figure (b) shows 5 triangles constructed from the base and two points on the circle.



**Figure (a)**  
**The base + 1 point**



**Figure (b)**  
**The base + 2 points**

### Questions:

- How many triangles can be constructed from the base and 3 points?
- How many triangles can be constructed from the base and 5 points?
- Using the base, at least how many points are needed in order to construct at least 120 triangles?